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The return to renewables: Will it help in global warming control?

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ABSTRACT

For all but the last 250 years, mankind was almost entirely dependent on renewable energy, mainly from biomass and wind. Then the era of fossil fuels downed and we shifted away from renewables. But excessive use of fossil fuel has now precipitated existence-threatening climate change and ocean acidification. So the world is once again reverting to renewables in a big way. It is as if the human quest for energy has come full circle. But will this 'home coming' bail us out of the global environmental crisis? This paper says it will not as long as we do not drastically reduce the largely conspicuous and wasteful consumption.

Contents

1. Till 250 years ago the world was almost entirely fuelled by renewable energy sources

Some 30,000 years ago humankind made the first of the three discoveries which were to change not only the lives of human beings but also the destiny of the entire planet earth. It was the discovery of how to start a fire, and this discovery was to influence the success of all other discoveries we subsequently made, including the two other destiny-shaping discoveries – of agriculture and of the wheel.

The discovery of how to set up a fire must have been purely accidental. A spark, perhaps generated while shaping a stone by rubbing it against another stone, might have made the dry leaves and twigs lying nearby catch fire. The pre-historic humans must have then repeated this act and then, by-and-by, increasingly developed the skill to set-up fires. They also, subsequently, learnt to control the fires.

We do not know whether the world's first-ever inventor was a male or a female. There is equal probability that it was either. Whatever be the gender of the discoverer, the discovery gave humankind its first reservoir of energy other than the food energy on which it had depended till then, and on which all other organisms depend to this day. But, whereas the activities of all other organisms remained limited by the very limited source of energy that they could utilize, in the form of food energy; discovery of generating fire from dry biomass provided humankind a huge auxiliary source of energy. With that we took our first step towards increasingly stronger – and perhaps disastrous – domination of planet earth.

We learnt newer and newer uses of fire. It was nothing else but ever-greater use of biomass energy. We learnt to lit fires to keep off predators. We used it to drive away other animals. When humankind discovered agriculture, biomass energy in the form of fire was used to clear land by burning off the vegetation we did not want. Biomass energy enabled the first bits of pottery to be shaped. After we discovered wheel and took the first step in transportation and mechanical engineering, biomass energy enabled us to extract metals and mould them. This gave us

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increasingly stronger wheels to enable increasingly swifter and heavier transportation. And it gave us more and more powerful weapons with which to conquer and subdue not only other animals but fellow human beings as well.

Our ever-increasing skills of utilizing the wheel then gave us access to other forms of energy, notably wind. We developed wind mills to grind grain, pull up water, and perform other functions. We did not learn to use solar energy directly till a few thousand years ago but, indirectly through agriculture, we had been appropriating solar energy since much longer. By agriculture (supported by biomass and wind energy, also passive solar energy for crop drying) we learnt to clear off plants we did not want while forcing the incident solar radiation to support only the plants we wanted. In this manner we diverted photosynthesis towards our choice of plant species.

By and by humankind learnt to generate heat by concentrating sunlight with the help of lenses or mirrors: 2220 years ago Archimedes used lenses to focus sun rays on the sails of enemy ships, setting them on fire. For several centuries furnaces were designed on similar principle. The French chemist Laviosier achieved temperatures up to 1700 °C using solar furnaces in the 18th century. Solar furnaces developed since then have achieved temperatures in excess of 3000 °C [1].

We also began using wind energy to power boats and ships. This enabled trans-continental travel which not only led to the first generation of globalization in trade, commerce, and exchange of knowledge but also invasions, wars, colonization and enslavement. Those nations who could build bigger ships and carry bigger armies attained greater maritime superiority compared to other nations. This advantage was also, tragically, used by most invaders to plunder and subjugate the regions that were invaded.

Humankind has also been using other sources of renewable energy directly or indirectly. For example streams heated naturally by geothermal energy have been used for bathing, space heating, etc. Hydropower has been used to obtain mechanical energy in the form of watermills. Flow of rivers and channels has been used to transport wood.

In this manner, it were the renewable energy sources on which humankind has depended right up to most of the 18th century for every aspect of its existence. Humankind had become aware of the existence of different types of fossil fuels, and in this or that part of the world fossil fuels were actually being used in a very limited way since over 2000 years, but the contribution of fossil fuels to global energy supply was like a drop in the ocean and the world was by-and-large being run almost entirely on renewable energy, principally biomass and wind. The world's fuel was biomass, and the charcoal derived from the biomass. If the transport on water was powered by human labour and wind, transport on land was fuelled entirely by animal energy – in the form of food or fodder used by human labourers, horses, bullocks, camels, donkies, etc.

The reason why mankind had been relying on renewable energy was not any higher environmental consciousness or any greater love of nature than the present-day human beings have. The reason simply was that we were not aware of the very huge reservoirs of fossil fuel that lay in the earth below nor we knew how to extract fossil fuels in large quantities. This situation began to change by the second half of 18th century. The first recorded mining of coal on commercial basis occurred in 1750, near Richmond, Virginia. Soon coal became the preferred fuel for steam engines because it carried more energy (i.e. generated more heat on combustion) than equivalent quantities of biomass-based fuels (firewood and charcoal). And coal was comparatively a cheaper and a much cleaner fuel as well! As the Industrial revolution spread from Britain to other parts of the world, the use of coal also spread proportionately. The world had entered the 'fossil fuel' era. About a 100 years after the commercial production of coal had stared, the first commercial oil well was drilled (in 1857 in Romania). From then onwards the world became increasingly bigger consumer of oil even as consumption of coal also went on increasing. This is how, the world went on a fossil-fuel consumption spree till global warming loomed on the horizon to put skids on the speeding world.

2. The present thrust to return to renewables

The first great wave in favour of shifting from fossil fuels to renewables had come in the early 1970s when the world had received its first 'oil shock' in 1973. In that year the group of OPEC (Oil Producing and Exporting Countries) had suddenly and unilaterally enhanced the price of petroleum crude. This action had a cascading effect on global economy because increase in the price of the crude led to an increase in the cost of production of almost everything else.

That was also the period during which the world was beginning to become increasingly aware of environmental pollution. This included the awareness that one of the main causes of pollution was the very large-scale use of fossil fuels.

In 1979 came the second 'oil shock' in the form of another price hike by the OPEC group. Then, in 1980 two of the biggest oil-rich countries – Iran and Iraq – went to war against each other. They targeted each other's oil refineries to cripple the economies of each other. This not only heightened the oil crisis but also raised the permanent issue of 'energy security' because it was realized that dependence on oil-rich countries was always fraught with the risk of the supplies begin reduced, cut, or made costlier. And since each and every economy of the present times is dependent on petroleum and other fossil fuels, 'energy security' translates to 'national security'.

The combined effect of these two happenings was that the world started looking at conventional energy sources – especially the ones based on coal, petrol, and diesel – as some kind of villains which were out to mess up the whole world. Large power plants which were once upon a time viewed with respect and affection – even devotion – as the harbingers of progress and prosperity suddenly acquired an ungainly taint. They began to be perceived as not only harming the environment but, with the rise in the price of petroleum due to the oil shocks, were seen as burning holes in our pockets as well. Dependence on fossil fuels endangered economic (and consequently political) security.

In the midst of these happenings calls for renewable energy sources were heard from different corners of the world. Renewables, it was argued, will never get exhausted as the non-renewables were likely to. Renewables will keep regenerating *ad infinitum*. Even more importantly, it was argued, renewables will be clean, benign, entities; and will not taint the environment as the non-renewables were doing. A lot of R&D was done on renewables. It produced the sobering realization that most renewables were not comparable to fossil fuels in terms of cost or ease-of-use; they were much costlier and a lot less handy. By mid-1980s the oil prices had fallen and most renewables became even less cost effective than they were when the oil prices were high. This turn of events pushed renewable energy sources to the margins of the energy basket till late 1990s. But their clean image endured.

Incidentally the world received another 'oil shock' in 2008 when the crude oil prices crossed USD 100 per barrel. That wave soon passed and the prices have come back to 'normal'. But the spurt did add momentum to the thrust towards renewables started a little earlier after global warming had become a widely accepted reality.

3. Global warming and renewables

Of all the forecasts of global environmental disasters made from time to time, the one which aroused the most widespread scepticism was about global warming. Even as several well-

Table 1
Potential of power obtainable from wind, small hydro, and biomass in India *vs* its actual realization at present [10].

Source	Estimated potential	Present installed capacity
Wind power	45,000 MW	3595 MW
Biomass power	16,000 MW	302.53 MW
Bagasse cogeneration	3500 MW	447.00 MW
Small hydro (up to 25 MW)	15,000 MW	1705.63 MW
Waste to energy		
Municipal solid waste	1700 MW	17 MW
Industrial waste	1000 MW	29.50 MW

meaning people took it seriously – some rather too seriously – a whole lot of other scientists and policy – makers dismissed it as over-exaggeration. During 1970s through 1990s those who believed in global warming talked of it as soon as they felt that a day was hotter than the previous one. Others believed that even if the world continued to produce gases which cause greenhouse effect, our oceans would keep assimilating them and no long-term global warming will ensue. They dismissed episodes of extreme climate as the usual fluctuations that occur in nature. Indeed during the late 1960s and early 1970s it was the forecast of global *cooling* that had captured public imagination [2–4].

But during the last 20 years the balance of evidence has gradually and decisively shifted towards global warming. It is now a scientifically accepted fact that global warming is indeed occurring and that it will have long-ranging impacts on the earth's ecosystems [5–8]. There is no longer any significant disagreement on the existence of global warming; if there is disagreement, it is on the extent of harm global warming will cause. There is also near-complete consensus that use of fossil fuels is the principal cause of global warming and unless the emissions to atmosphere of CO_2 and other greenhouse gases are drastically reduced, global warming will progressively increase and lead the world to extinction.

By all accounts, global warming has already hit us, and it is beginning to hit us harder. It has also produced another monster which may be even more destructive than temperature rise – ocean acidification [9]. Given that 70% of the world is covered by oceans, any disturbance in oceans can have bigger and 'deeper' effects on earth than the disturbances in the rest of the 30% of the world!

With this, once again, there is a groundswell of demand for 'alternative energy sources', particularly the 'renewables'. Even before global warming became an accepted reality in the post-modern era, fossil fuels were almost universally perceived as highly 'unclean' fuels responsible for numerous forms of gross pollution, including acid rain [10]. In contrast nonconventional energy sources, particularly the renewable ones, have enjoyed a 'clean' image *vis a vis* environmental impacts. The one major exception to this general trend has been large hydropower projects; experience has taught us that they can be disastrous for the environment. The belief now is that minihydel and microhydel projects are harmless alternatives [1].

The tide has turned so strongly in favour of renewables that for the first time ever since the dawn of the fossil fuel era over two hundred years ago, renewable energy technologies have attracted more investment globally ($140 billion), in 2008, compared with $110 billion for fossil fuel-based technologies according to figures released by the United Nations, June 2009 [11]. Wind energy has attracted the highest new worldwide investment, $51.8 billion, followed by solar at $33.5 billion. Biofuels are the next most popular investment, winning $16.9 billion. There is as much as a 27 per cent rise to $36.6 billion in developing countries led by China, which pumped in $15.6 billion, mostly in wind and biomass plants. India's overall spending on renewable energy has risen to $4.1 billion in 2008, 12 per cent up on 2007 levels.

According to India's Ministry for New and Renewable Energy [12] India has a potential of generating over 82,000 MW (8.2 GW) of power from just wind, small hydro and biomass (Table 1). Of this only about 6100 MW, i.e., a mere 7.4% of the potential is presently being realized. There is a similarly vast potential for dispersed units but only a small fraction has been realized (Table 2). Which is why India has stepped up its spending on renewables, just as the rest of the world has. It is as if the world is preparing to stake its all on renewables in the hope that renewables will save it from the looming disaster of global warming and irreversible pollution.

4. Will the return to renewables solve the problems of global warming and pollution?

But are renewable energy sources really as benign as is widely believed? Are they really a sure answer to the problem of global warming?

One may say that for thousands of years when humankind was dependant almost totally on renewables, the world was much less polluted and there was no global warming. Is this itself not a major proof that renewables are environment friendly?

Sadly it is not!

The reason is that till the mid 18th century the global population and the per capita energy consumption, hence the *total* global energy consumption, were small fractions of what it is today. Had we used fossil fuels at the rate renewable sources were being used till 1850, we would not have experienced global warming. But at the present rate of population growth and per capita consumption no source of energy, however clean it may be, can bail us out of rapidly increasing global warming and other forms of pollution. India, in its National Electricity Policy 2005 [10], has set for itself the goals of, among other things: (a) access to electricity for all and (b) increase in per capita availability to over 1000 units by 2012. In other words we want to greatly enhance energy consumption. In doing it we will have to face the inevitable consequence of more serious pollution. And, as has been brought

Table 2
Potential of utilization of biogas and dispersed solar energy, biomass and wind energy systems in India, and the present state of its realization [10].

System	Estimated potential	Present number of installations
Family size biogas plants	12 million	3.71 million
Improved chulhas	120 million	35.20 million
Solar street lighting systems	Not estimated	54 795
Home lighting systems	–	342 607
Solar lanterns	–	560 295
Solar photovoltaic power plants	–	1566 kWp
Solar water heating systems	140 million m^2 of collector area	1 million m^2 of collector area
Box-type solar cookers	Not estimated	575,000
Solar photovoltaic pumps	–	6818
Wind pumps	–	1087
Biomass gasifiers	–	66.35 MW

out earlier [1,13,14] renewables are not as squeaky clean as is popularly believed. Nor is the use of renewable energy sources on a large scale an insignificant burden on the environment.

The world is striving hard to shift from fossil fuel economy to hydrogen economy [15] but 'renewable' hydrogen is far too expensive to be economical while other forms of hydrogen production consume more fossil fuels than the use of the hydrogen can save [16,17].

Hence, there is little hope of escaping worsening climate and increasing pollution of the earth unless we drastically reduce consumption of energy and natural resources on the global scale. Only then can a shift to renewables may reduce the presently increasing rate of global warming and ecodegradation.

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